



## **DHCPv6 Protocol**

**Teldat Dm806-I**

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# I Related Documents

Teldat Dm805-I IPv6 Addressing

# Chapter 1 Introduction

## 1.1 DHCPv6 Protocol: Introduction

The DHCPv6 protocol (*Dynamic Host Configuration Protocol for IPv6*, RFC 3315) provides a mechanism to exchange configuration information (such as IPv6 prefixes, IPv6 addresses, DNS servers, SIP servers, domain names, NTP servers, etc.) between DHCPv6 servers and clients in an IPv6 network.

DHCPv6, like DHCP, is built on a client/server model, where a DHCPv6 server assigns network addresses, IPv6 prefixes and delivers configuration parameters to clients to be configured dynamically.

The DHCPv6 server supports two different configuration methods, *Stateful* and *Stateless*. The Stateful DHCPv6 server keeps a record of the information it provides to individual clients at all times, thus, it is a *Stateful* address auto-configuration protocol. Another possible configuration would be to use the DHCPv6 server in *Stateless* mode (i.e., without stateful information on the configuration assigned to clients). In this mode, the server is used together with the *Stateless* address autoconfiguration protocol (*IPv6 Stateless Address Autoconfiguration*, RFC 4862). When using SLAAC, clients would be assigned prefixes to enable them to build addresses and they would be notified by the *Other-Config* flag that they need to use the DHCPv6 *Stateless* server to obtain other stateless configuration information. In this case, the *Stateless* DHCPv6 server would assign stateless configuration information (such as DNS servers, domain names, SIP servers, NTP servers, etc.).

Our devices can be configured to be both client and server with some restrictions in functionality. This manual will be updated as levels of functionality in both increase. When configured to be a DHCPv6 server, the latter can only act in *Stateless* mode, assigning clients DNS IPv6 servers and domain names (*Stateless Dynamic Host Configuration Protocol DHCP Service for IPv6*, RFC 3736). However, in client mode, the server can dynamically obtain an IPv6 prefix provided by a server configured to that effect (*IPv6 Prefix Options for Dynamic Host Configuration Protocol DHCP version 6*, RFC 3633) and stateless configuration parameters (like DNS servers and domain names).

## 1.2 Protocol

The DHCPv6 protocol is built using a client/server architecture, where clients and servers exchange DHCPv6 messages using UDP (*User Data Protocol*) over port 546 for DHCPv6 clients and port 547 for DHCPv6 servers. Clients use their *link-local* address or other addresses determined by other mechanisms in order to transmit and receive DHCPv6 messages.

The DHCPv6 servers receive the messages from the clients using a reserved multicast address: FF02::1:2.

The following shows the exchange of DHCPv6 messages between client and server in the case of a client requesting delegation of an IPv6 prefix:

- The client sends a *Solicit* message containing the **IA\_PD** option (*Identity Association for Prefix Delegation*), which includes its identifier (IAID) and the Client identifier. It also includes a Request Option (ORO) soliciting DNS Recursive Name Servers [option 23] and Domain Search List [option 24].
- Servers with delegation prefixes respond to the client with an *Advertise* message containing information on the available prefixes, the Client identifier that sent the request and its Server identifier. If the server is configured to send stateless configuration information, it will attach a list of DNS servers and a list of domain names.
- When the client receives the message, it sends a *Request* message with the IA\_PD option with the prefix it wants assigned, its Client identifier and the Server identifier selected from among those that responded to the request. The Request Option is appended to the packet requesting DNS servers [option 23] and a list of domain names [option 24].
- The selected DHCPv6 server then responds to the *Request* by sending a *Reply* message confirming the indicated prefix, along with the prefix lifetimes and the T1 and T2 times. These correspond, respectively, to the time that must lapse before the client restarts prefix renewal with the previous server (sending *Renew* messages) and to the time that must lapse until the client restarts prefix renewal with any DHCPv6 server in the link (if after sending the *Renew* messages there was no response). The corresponding Client and Server identifiers are also included. If the server is configured to send stateless configuration information, it will attach a list of DNS servers and a list of domain names.

Clients who have obtained an IPv6 address through some other mechanism (SLAAC or manual configuration), can use the *Stateless* DHCPv6 server to obtain other configuration settings (DNS servers, SIP servers, and so forth). The DHCPv6 server is not used to assign addresses, only to provide configuration information. The term "stateless" means that it does not need to maintain a dynamic state for each client in the network.

The following shows the exchange of *Stateless* DHCPv6 messages between client and server in the case of a client requiring information about the DNS IPv6 servers and domain names to use:

- The client sends a DHCP *Information-request* message indicating that it is requesting configuration information.

The message contains the client identifier (Client Identifier [DUID and DUID type]) and the **option request** field (specifies the configuration options that it wants to receive from the server). In the case of the options supported by Teldat's DHCPv6 server, it would request the list of DNS IPv6 servers, the list of domain names and the recommended refresh time of the parameters (DNS Recursive Name Server [option 23], Domain Search List [option 24] and Information Refresh Time [option 32]).

- The *Stateless* DHCPv6 server responds to the previous message with a *DHCP reply* message containing the configuration information for the client. This message provides the identifier of the previous client, the Server Identifier, the DNS Recursive Name Server field with the list of DNS IPv6 server addresses, the Domain Search List field with the list of domain names and the recommended refresh time of the parameters given. The server does not store any kind of stateful information on clients.



#### Important

Teldat's *Stateless* DHCPv6 server only supports the following options:

- **DNS Recursive Name Servers:** DNS IPv6 servers that the client uses for name resolution.

- **DNS search list:** specifies domain names to be used for name resolution by clients.

**Information Refresh Time:** specifies the period of time that the client should wait before refreshing the configuration parameters. This parameter can have two possible values: 600 seconds (**IRT\_MINIMUM**) or 86400 seconds (**IRT\_DEFAULT**). The first value is returned when some of the parameters that the server is offering are imported from the DHCPv6 client. This configuration information is obtained through the prefix delegation process, which means that it will be renewed in the near future when the client restarts the prefix renewal. As the current prefix lifetime value can be lower than **IRT\_MINIMUM**, the RFC 4242 states that the minimum value for this option (Information Refresh Time [32]) is **IRT\_MINIMUM**. If no parameter is imported from the DHCPv6 client, it is not known when these values are going to change, if they do. The RFC 4242 states that if no value is assigned to this option (Information Refresh Time [32]), the value must be **IRT\_DEFAULT**.

- The client will receive this message and will set up the configuration using the information received.

## 1.2.1 Message Format

The DHCPv6 protocol exchanges messages using the following format:

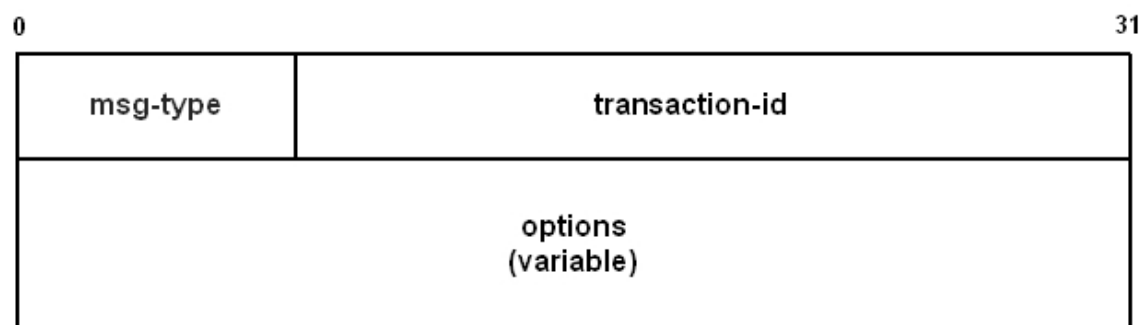


Fig. 1: DHCPv6 message format.

Where,

- *msg-type*: Identifies the type of DHCPv6 message. This can be:

SOLICIT (1)

ADVERTISE (2)

REQUEST (3)

CONFIRM (4)

RENEW (5)

REBIND (6)

REPLY (7)

- RELEASE (8)
- DECLINE (9)
- RECONFIGURE (10)
- INFORMATION-REQUEST (11)
- RELAY-FORW (12)
- RELAY-REPL (13)

- *transaction-id*: Indicates the transaction identifier for this message exchange.
- *options*: Details the different options included in this message.

We will now describe the options needed to delegate a prefix (among those possible):

- *Client Identifier* option and *Server Identifier* option:

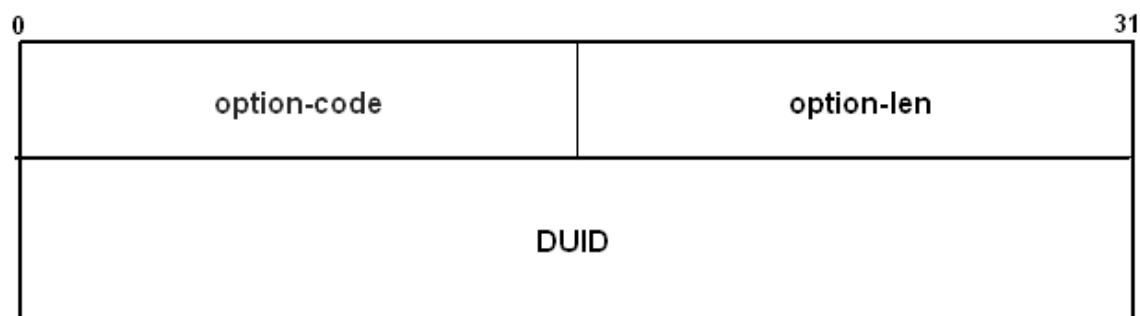


Fig. 2: Client Identifier option and Server Identifier option.

Where

- *option-code*: indicates the option code, which is 1 in the Client Identifier option and 2 in the Server Identifier option.
- *option-len*: length of the option, given that this is variable.
- *DUID*: DHCPv6 Unique Identifier, which identifies the Client and the Server. There are three methods to obtain these:
  - Layer 2 address plus time reference.
  - Unique identifier assigned by the manufacturer.
  - Layer 2 address.
- *Identity Association for Prefix Delegation (IA\_PD)* option: this is used to store information on the delegated prefixes together with the parameters common to them all.

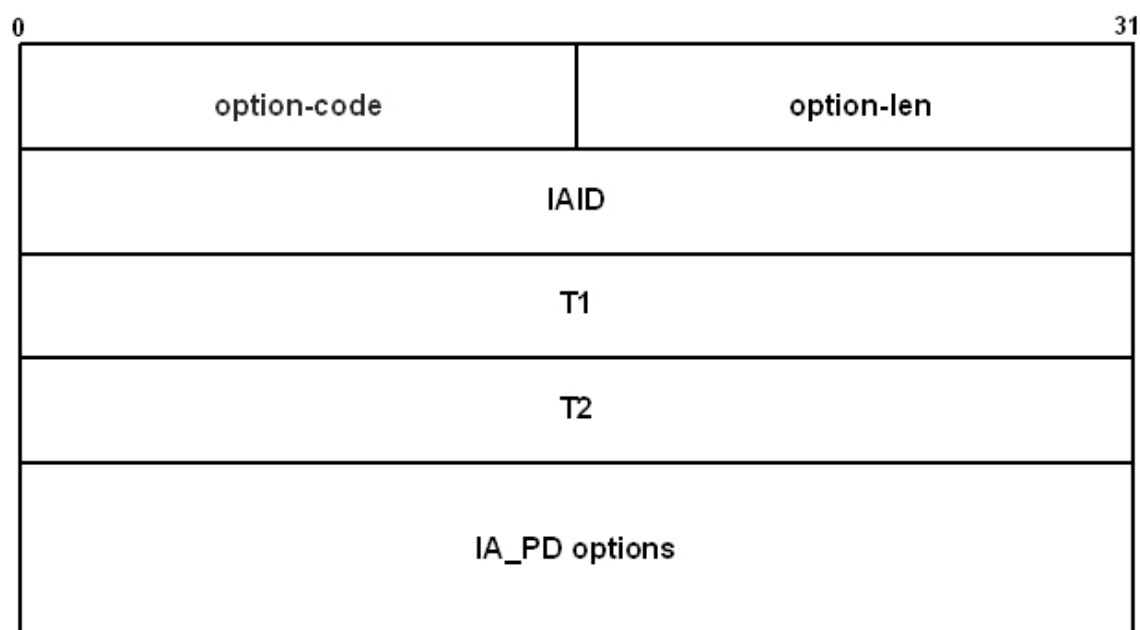


Fig. 3: Identity Association for Prefix Delegation option.

Where

- *option-code*: indicates the option code (25).
- *option-len*: option length, which is equal to 12 bytes plus the length of the options.
- *IAID*: unique identifier for this IA\_PD option.
- *T1*: time (expressed in seconds) after which the client must contact the server that he got the prefixes from in order to renew them.
- *T2*: time (expressed in seconds) after which the client must contact any server in the link to extend the lifetimes for the IA\_PD prefixes.
- *IA\_PD-options*: options associated with this IA\_PD (such as the delegated prefixes and their respective parameters):

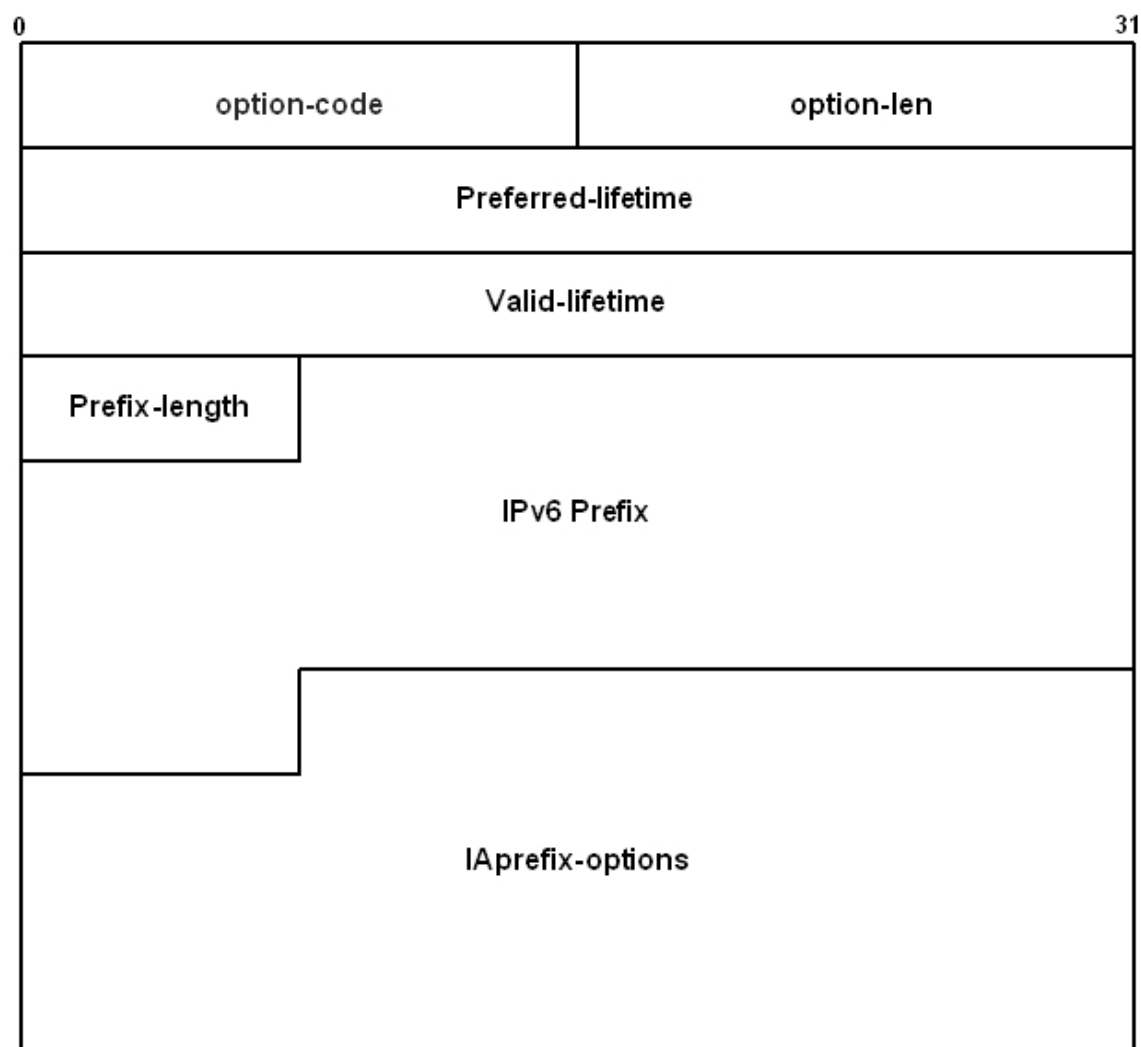


Fig. 4: IA\_PD-options field format.

Where

- *option-code*: OPTION\_IAPREFIX (26)
- *option-length*: 25 + the length of the IAprefix-options field
- *preferred-lifetime*: preferred lifetime (expressed in seconds) for the prefix included in the option. A 0xFFFFFFFF value represents infinite.
- *valid-lifetime*: valid lifetime of the prefix included in the option (expressed in seconds). A 0xFFFFFFFF value represents infinite.
- *prefix-length*: prefix length in bits.
- *IPv6-prefix*: IPv6 prefix.
- *IAprefix-options*: options associated with this prefix.



## Chapter 2 Configuration

### 2.1 Configuring the DHCPv6 protocol

Our routers can be configured to be both clients requesting a delegated IPv6 prefix and *Stateless* DHCPv6 servers that provide the *DNS Recursive Name Servers* and *DNS search list* configuration options.

A DHCPv6 client transmits a solicit message requesting IPv6 prefixes and other configuration parameters that allow it to initialize in the network. To do this, it sends multicast messages addressed to servers or relay agents located in the same physical subnet, triggering an exchange of DHCPv6 messages that leads to a server delegating a prefix to the client. Our router can acquire a delegated prefix dynamically, which is then associated with a general prefix and can be used to configure IPv6 addresses in any interface on the device. When the device is acting as a router, it sends the prefixes through *Router Advertisement* (RA) messages in the interfaces where the IPv6 address has been configured with this prefix.

It should be noted that you can only enable the DHCPv6 client on one of the device's interfaces, while the delegated prefix can be used to autoconfigure IPv6 addresses on any interface in the device.

The *Stateless* DHCPv6 server can be enabled on multiple interfaces in the device to provide configuration information to clients in the network.

### 2.2 DHCPv6 client configuration

In our router, you can enable this behavior on any IPv6-enabled interface. Simply activate the DHCPv6 client and indicate a name that will be used to identify said prefix (that is, the name the general prefix will receive).

#### 2.2.1 Enabling a DHCPv6 client interface

To enable the DHCPv6 client on an interface, enter the **ipv6 dhcp client pd** command from the interface's configuration menu, followed by the general prefix name associated with the prefix.

*Example:*

```
*config
Config>network ethernet0/0
-- Ethernet Interface User Configuration --
ethernet0/0 config>ipv6 dhcp client pd dhcp-delegated-prefix
ethernet0/0 config>
```

When said command is entered from the dynamic configuration process (**P5** or **running-config**), the device will immediately begin to behave as a DHCPv6 client, initiating the message exchange with the servers or relay agents in the network that the interface in question is connected to. If, instead, you enable behavior as DHCPv6 client from the static configuration process (**P4** or **config**), you need to save the configuration and restart the device so this feature activates. In either case, the process finalizes with a DHCPv6 server delegating an IPv6 prefix and configuration parameters (like DNS servers and domain names) when configured to.

As already stated, this prefix can be used to configure IPv6 addresses on any device interface. To do this (as shown in **Teldat Dm805-1 IPv6 Addressing**), run **ipv6 address general-prefix** followed by the name associated with the delegated prefix and the sub-prefix, and the identifier of the host that is going to be linked to the delegated prefix in order to form the address to be configured.

The stateless configuration parameters received can be imported to the server pool, so they can be offered to the DHCPv6 server clients.

*Example:*

```
*config
Config>network ethernet0/1
-- Ethernet Interface User Configuration --
ethernet0/1 config>ipv6 address general-prefix dhcp-delegated-prefix ::1/64
ethernet0/1 config>
```

To disable the DHCPv6 client feature, run **no ipv6 dhcp client pd**.

*Example:*

```
ethernet0/0 config>no ipv6 dhcp client pd
```

```
ethernet0/0 config>
```

## 2.3 Stateless DHCPv6 server configuration

### 2.3.1 Stateless DHCPv6 server configuration per interface

To enable the DHCPv6 server on an interface, run **ipv6 dhcp server enable** from the interface configuration menu. From then on, the *Stateless* DHCPv6 server will hear configuration requests from clients for that interface. The DHCPv6 server can be enabled on multiple interfaces to provide the same configuration information.

```
DHCPv6Server *running-config
DHCPv6Server Config$network <interface>
-- ***** Configuration --
DHCPv6Server <interface> config$ipv6 dhcp ?
  client      Client dhcp ipv6 configuration
  server      DHCPv6 server configuration
DHCPv6Server ethernet0/0 config$ipv6 dhcp server ?
  enable      Enables DHCPv6 server on this interface
```

*Example:*

In the following example, the *Stateless* DHCPv6 server is enabled on the ethernet0/0 interface.

```
DHCPv6Server *running-config
DHCPv6Server Config$network ethernet0/0
-- Ethernet Interface User Configuration --
DHCPv6Server ethernet0/0 config$ipv6 dhcp server enable
```

**Command history:**

Release	Modification
11.00.03	This command was implemented in release 11.00.
11.00.01.01.02	This command was implemented in release 11.00.01.01.02

### 2.3.2 Stateless DHCPv6 server global configuration

The *Stateless* options that the DHCPv6 server will deliver to clients upon request are specified in the DHCPv6 protocol global configuration. In the particular case of supported options, the list of DNS IPv6 servers and domain names.

First, access the *Stateless* DHCPv6 server menu as follows:

```
DHCPv6Server *running-config
DHCPv6Server Config$protocol dhcpv6
-- DHCPv6 protocol user configuration --
DHCPv6Server DHCPv6 config$?
  server      Access the DHCPv6 Server configuration menu
  exit
DHCPv6Server DHCPv6 config$server ?
  <cr>
DHCPv6Server DHCPv6 config$server
-- DHCPv6 Server Configuration --
```

Run **option** (DHCPv6 server menu) to configure the desired options (configuration information for clients). Run **import** (DHCPv6 server menu) to add the parameters leased to the DHCPv6 client to the server pool.

```
DHCPv6Server DHCPv6-Server config$?
  import      Adds to the server pool the parameters learnt by the DHCPv6 Client
  no          Negate a command or set its defaults
  option      Configure DHCPv6 Server options
  exit
DHCPv6Server DHCPv6-Server config$option ?
  dns-server  Configure DNS server option
  domain-search  Configure domain search option
```

```
DHCPv6Server DHCPv6-Server config$import ?
  dns-server      Import DNS recursive name servers to the server pool
  domain-search   Import Domain Search List to the server pool
  all             Import every leased option obtained by the DHCPv6 Client to the server pool
```

### 2.3.2.1 DNS-Server option

If you want to specify a DNS IPv6 server, run **option dns-server** followed by the DNS IPv6 address. You can add as many DNS servers as you like using the same command.

```
DHCPv6Server DHCPv6-Server config$option dns-server ?
<a::b>      Ipv6 address
```

*Example:*

In the following example, the *Stateless* DHCPv6 server is configured to offer clients the DNS 2001:db8::100 server.

```
DHCPv6Server *running-config
DHCPv6Server Config$protocol dhcpv6
-- DHCPv6 protocol user configuration --
DHCPv6Server DHCPv6 config$server
-- DHCPv6 Server Configuration --
DHCPv6Server DHCPv6-Server config$option dns-server 2001:db8::100
```

**Command history:**

Release	Modification
11.00.03	This command was implemented in release 11.00.
11.00.01.01.02	This command was implemented in release 11.00.01.01.02

### 2.3.2.2 Domain-Search Option

To specify a domain name, run **option domain search** followed by the domain name. You can add as many domain names as you like using the same command.

```
DHCPv6Server DHCPv6-Server config$option domain-search
<word>      Text
```

*Example:*

In the following example the *Stateless* DHCPv6 server is configured to offer the example.test domain name to clients.

```
DHCPv6Server *running-config
DHCPv6Server Config$protocol dhcpv6
-- DHCPv6 protocol user configuration --
DHCPv6Server DHCPv6 config$server
-- DHCPv6 Server Configuration --
DHCPv6Server DHCPv6-Server config$option domain-search example.test
```

**Command history:**

Release	Modification
11.00.03	This command was implemented in release 11.00.
11.00.01.01	This command was implemented in release 11.00.01.01.

### 2.3.2.3 Deleting an option

To delete a particular option, run **no** followed by the preconfigured option.

```
DHCPv6Server DHCPv6-Server config$no ?
  option      Configure DHCPv6 Server options

DHCPv6Server DHCPv6-Server config$no option ?
  dns-server  Configure DNS server option
  domain-search  Configure domain search option

DHCPv6Server DHCPv6-Server config$no option dns-server ?
<a::b>      Ipv6 address
```

```
DHCPv6Server DHCPv6-Server config$no option domain-search ?
<word>      Text
```

*Example:*

In the following example the DNS 2001:db8::100 server and the example.test domain name are deleted. These options will no longer be delivered to IPv6 clients upon request.

```
DHCPv6Server *running-config
DHCPv6Server Config$protocol dhcpv6
-- DHCPv6 protocol user configuration --
DHCPv6Server DHCPv6 config$server
-- DHCPv6 Server Configuration --
DHCPv6Server DHCPv6-Server config$no option dns-server 2001:db8::100
DHCPv6Server DHCPv6-Server config$no option domain-search example.test
```

**Command history:**

Release	Modification
11.00.03	This command was implemented in release 11.00.
11.00.01.01	This command was implemented in release 11.00.01.01.

### 2.3.2.4 DNS-Server import

This command adds the DNS recursive name servers obtained by the DHCPv6 client to the server pool. When this option is configured, the server will offer these DNS servers to its DHCPv6 clients. This option disables the **import all** command.

*Example:*

In the following example, the *Stateless* DHCPv6 server is configured to import the DNS servers received by the DHCPv6 client.

```
DHCPv6Server *running-config
DHCPv6Server Config$protocol dhcpv6
-- DHCPv6 protocol user configuration --
DHCPv6Server DHCPv6 config$server
-- DHCPv6 Server Configuration --
DHCPv6Server DHCPv6-Server config$import dns-server
```

**Command history:**

Release	Modification
11.01.06	This command was implemented in release 11.01.06

### 2.3.2.5 Domain-Search import

This command adds the Domain Search List obtained by the DHCPv6 client to the server pool. When this option is configured, the server will offer these domain names to its clients. This option disables the **import all** command.

*Example:*

In the following example, the *Stateless* DHCPv6 server is configured to import the Domain Search List obtained by the DHCPv6 client to the server pool.

```
DHCPv6Server *running-config
DHCPv6Server Config$protocol dhcpv6
-- DHCPv6 protocol user configuration --
DHCPv6Server DHCPv6 config$server
-- DHCPv6 Server Configuration --
DHCPv6Server DHCPv6-Server config$import domain-search
```

**Command history:**

Release	Modification
11.01.06	This command was implemented in release 11.01.06

### 2.3.2.6 Import all

This command configures all the previously mentioned options, which means that the server automatically adds all the parameters received by the DHCPv6 client to the pool. This option disables the **import dns-server** and the **import domain-search** commands.

*Example:*

In the following example, the *Stateless* DHCPv6 server is configured to import all the parameters obtained by the DHCPv6 client.

```
DHCPv6Server *running-config
DHCPv6Server Config$protocol dhcpv6
-- DHCPv6 protocol user configuration --
DHCPv6Server DHCPv6 config$server
-- DHCPv6 Server Configuration --
DHCPv6Server DHCPv6-Server config$import all
```

#### Command history:

Release	Modification
11.01.06	This command was implemented in release 11.01.06

## Chapter 3 Monitoring

### 3.1 Monitoring the DHCPv6 protocol

There are two different menus for monitoring information relating to the DHCPv6 protocol. The first, the IPv6 protocol monitoring menu, shows the delegated prefixes. To view them, run the **general prefixes** monitoring command as explained in Teldat **Dm805-I IPv6 Addressing**. This monitoring shows the delegated prefixes received from the DHCPv6 server and their corresponding lifetimes (valid and preferred lifetimes), and the interfaces where the prefix is being used to configure an IPv6 address. They are labeled dhcp to distinguish them from user-configured prefixes.

*Example:*

```
*monitor
Console Operator
+ protocol ipv6
-- IPv6 protocol monitor --
IPv6+list general-prefix
General-prefix name: dhcp-delegated-prefix
  General-prefix          2001:db8:ffff::/48 (dhcp) valid lifetime 2591856s,
                          preferred lifetime 604656s
  Address on ethernet0/0  ::2/64
  Address on ethernet0/1  ::1/64
IPv6+
```

The second menu for monitoring information relating to this protocol is the DHCPv6 protocol monitoring menu. This menu shows information about the client and server. The client information lists the received parameters, while the server information displays the current configuration pool parameters.

```
*monitor
Console Operator

+protocol dhcpv6

-- DHCPv6 protocol monitor --

DHCPv6+
```

Events relating to the DHCPv6 client are found in the DH6C subsystem.

Events relating to the DHCPv6 server are found in the DH6S subsystem.

### 3.2 DHCPv6 protocol monitoring commands

The following options allow you to monitor information relating to the DHCPv6 protocol:

```
*monitor
Console Operator

+protocol dhcpv6

-- DHCPv6 protocol monitor --

DHCPv6+?
  client  Access the DHCPv6 Client monitoring menu
  server  Access the DHCPv6 Server monitoring menu
  exit
```

#### 3.2.1 Client monitoring

This menu allows you to access information relating to the DHCPv6 client. Here you can list the configuration parameters received by the client. The following commands are available in this menu:

```
DHCPv6+client
```

```
DHCPv6-Client+?
list    Lists all the parameters obtained by the DHCPv6 Client
exit
```

### 3.2.1.1 List

This command displays all the configuration parameters received by the DHCPv6 client. It also displays the elapsed time since they were obtained and the amount of seconds until the next renewal process.

*Example:*

```
DHCPv6-Client+list
Client on interface ethernet0/1
DNS server/s:
  1. 2001:db8:3000:3000::42      Uptime: 3m48s Renew in: 72 seconds
  2. 2001:db8:6000:6000::21      Uptime: 3m48s Renew in: 72 seconds
  3. 2001:db8:9000:9000::84      Uptime: 3m48s Renew in: 72 seconds
Domain Search List:
  4. example.com                Uptime: 3m48s Renew in: 72 seconds
  5. google.com                 Uptime: 3m48s Renew in: 72 seconds
```

#### Command history:

Release	Modification
11.01.06	This command was implemented in release 11.01.06

## 3.2.2 Server monitoring

This menu allows you to display the configuration parameters that the DHCPv6 server is offering to clients requesting stateless configuration. It shows the statically-defined options and the parameters imported from the DHCPv6 client. The available commands are:

```
DHCPv6+server
DHCPv6-Server+?
list    Displays the parameters that are being served to the clients
exit
```

### 3.2.2.1 List

This command shows all the configuration parameters that the DHCPv6 server is sending to the clients. If the parameter is imported from the client it is tagged as "Imported".

*Example:*

```
DHCPv6-Server+list
DNS server/s:
  1. 2001:db8::300
  2. 2001:db8::500
  3. 2001:db8:3000:3000::42      (Imported)
  4. 2001:db8:6000:6000::21      (Imported)
  5. 2001:db8:9000:9000::84      (Imported)
Domain Search List:
  1. domain.example2
  2. example.com                (Imported)
  3. google.com                 (Imported)
```

#### Command history:

Release	Modification
11.01.06	This command was implemented in release 11.01.06

## Chapter 4 DHCPv6 Configuration Examples

### 4.1 “DHCPv6 Client” scenario

Consider the following example scenario:

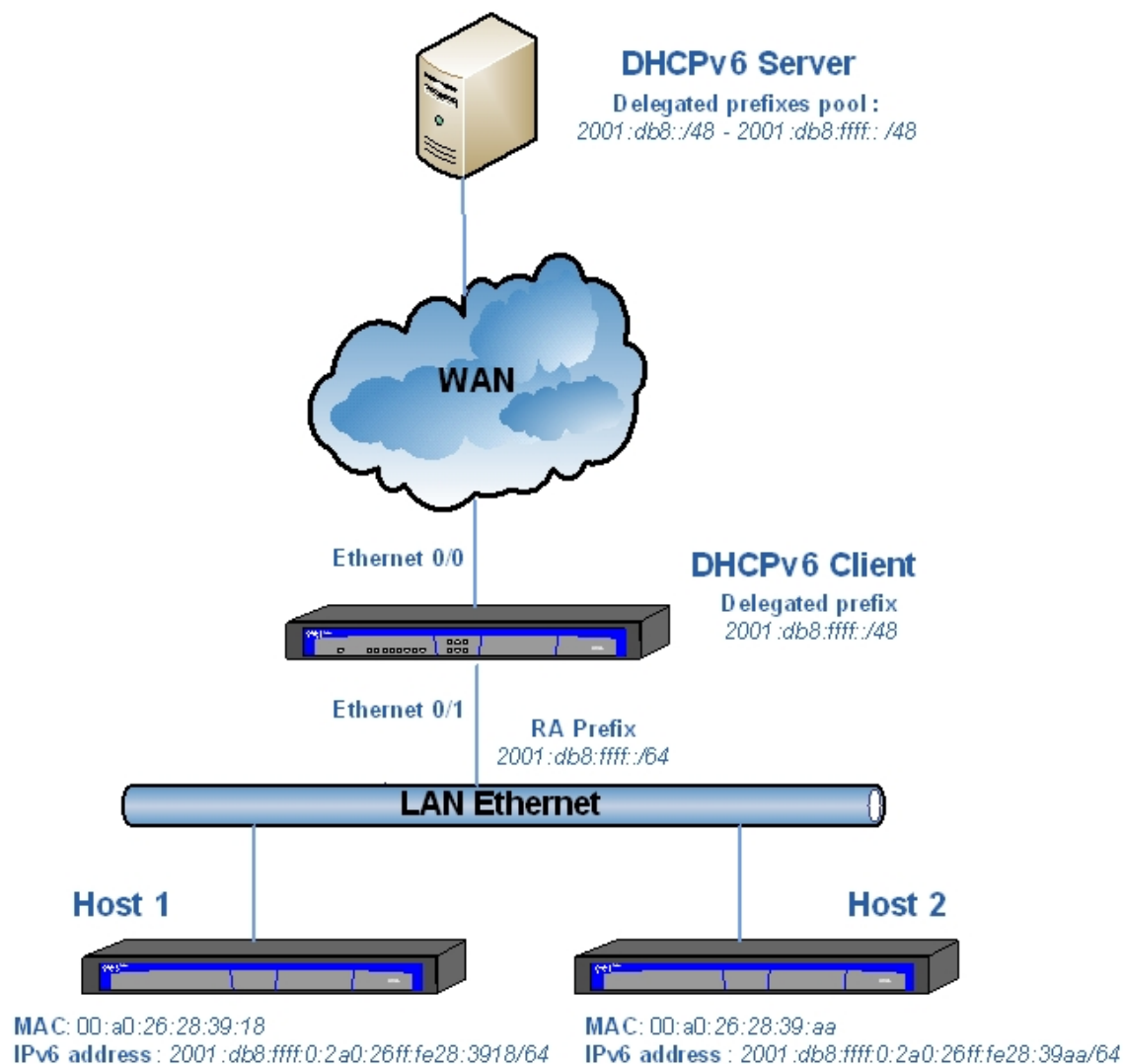


Fig. 5: Configuration example scenario

A *DHCPv6 Server* is responsible for delegating IPv6 prefixes to devices connected to the WAN network.

A *DHCPv6 Client* receives the delegated prefix through the interface connected to the WAN (ethernet0/0) and uses it to configure an IPv6 address on its interface connected to the LAN (ethernet0/1). This results in *Router Advertisement* (RA) messages being sent to the LAN so that the connected Hosts autoconfigure using the advertised prefix.

To configure the router to behave as a DHCPv6 client, carry out the following actions.

#### 4.1.1 Configuring the device in Router mode

Access the IPv6 protocol global configuration menu and enable forwarding:

```
DHCPv6Client *running-config
DHCPv6Client Config$protocol ipv6
-- IPv6 user configuration --
DHCPv6Client IPv6 config$unicast-routing
DHCPv6Client IPv6 config$
```



## 4.1.2 Enabling the DHCPv6 Client on the WAN

Access the interface configuration menu (connected to the WAN) and enable the IPv6 and DHCPv6 client:

```
DHCPv6Client *running-config
DHCPv6Client Config$network ethernet0/0
-- Ethernet Interface User Configuration --
DHCPv6Client ethernet0/0 config$ipv6 enable
DHCPv6Client ethernet0/0 config$ipv6 dhcp client pd dhcp-delegated-prefix
DHCPv6Client ethernet0/0 config$
```

## 4.1.3 Configuring an address with the delegated prefix on the LAN

Access the configuration menu of the interface connected to the LAN, enable IPv6 and configure an IPv6 address from the general prefix where the DHCPv6-delegated prefix is stored. As previously mentioned, on configuring an IPv6 address, as the device is configured in Router mode, RA sending is initiated by said interface.

```
DHCPv6Client *running-config
DHCPv6Client Config$network ethernet0/1
-- Ethernet Interface User Configuration --
DHCPv6Client ethernet0/1 config$ipv6 enable
DHCPv6Client ethernet0/1 config$ipv6 address general-prefix dhcp-delegated-prefix ::1/64
DHCPv6Client ethernet0/1 config$
```

As you can see, the prefix advertised by the LAN in the RAs is the prefix delegated by the DHCPv6 extended to 64 bits so the devices connected to the LAN can autoconfigure.

The resulting configuration for the DHCPv6 client is as follows:

```
log-command-errors
no configuration
set hostname DHCPv6Client
set data-link x25 serial0/1
network ethernet0/0
; -- Ethernet Interface User Configuration --
    ipv6 enable
    ipv6 dhcp client pd dhcp-delegated-prefix
exit
;
network ethernet0/1
; -- Ethernet Interface User Configuration --
    ipv6 enable
    ipv6 address general-prefix dhcp-delegated-prefix ::1/64
exit
;
;
    protocol ipv6
; -- IPv6 user configuration --
    unicast-routing
exit
;
;
    dump-command-errors
end
DHCPv6Client Config$
```

You can see the prefix with this configuration by running a general prefix listing once you have received the delegated prefix from the DHCPv6 server. In the same way, you can see the configured address and the prefix sent in the RAs by listing the state of the interface where this is configured (ethernet0/1):

```
DHCPv6Client *monitor
Console Operator
DHCPv6Client +protocol ipv6
-- IPv6 protocol monitor --
DHCPv6Client IPv6+list general-prefix

General-prefix name: dhcp-delegated-prefix
General-prefix          2001:db8:ffff::/48 (dhcp) valid lifetime 2591977s,
```

```

                                preferred lifetime 604777s
  Address on ethernet0/1          ::1/64
DHCPv6Client IPv6+
DHCPv6Client IPv6+list interface ethernet0/1

Interface ethernet0/1:
-----
IPv6 is Enabled
Link-local address is: fe80::2a0:26ff:fe32:28c9 [PERM]

Global unicast address(es):
  2001:db8:ffff::1/64 gen-pref [UP] valid lifetime 2591960s, preferred lifetime 604760s

Joined group address(es):
  ff02::1:ff00:1
  ff02::1:ff00:0
  ff02::1:ff32:28c9
  ff02::2
  ff02::1

MTU is 1500 bytes
ICMP error messages limited to one every 1000 milliseconds
ICMP redirects are enabled
ICMP unreachable are sent
ND DAD is enabled, number of DAD attempts: 1
ND reachable time is 30000 milliseconds
ND advertised reachable time is 0 milliseconds (unspecified)
ND advertised retransmit interval is 0 milliseconds (unspecified)
ND router advertisements are sent every 10 to 30 seconds
ND router advertisements live for 1800 seconds
ND advertised default router preference is Medium

IPv6 Prefix Advertisements ethernet0/0
Codes: A - Address, P - Prefix-Advertisement, N - Not advertised,
       [L] - On-link, [A] - Autonomous
A 2001:db8:ffff::/64 [LA] Valid lifetime: 2592000, preferred lifetime: 604800
DHCPv6Client IPv6+

```

## 4.2 “Stateless DHCPv6 Server scenario

In the following scenario, the device is configured as a *Stateless* DHCPv6 server to hand out DNS IPv6 servers and domain names to clients. Clients acquire IPv6 addresses through SLAAC, thanks to the IPv6 prefix being advertised in the Router Advertisement (RA).

### 4.2.1 Configuring the device in Router mode

Access the IPv6 protocol global configuration menu and enable forwarding:

```

DHCPv6Server *running-config
DHCPv6Server Config$protocol ipv6
-- IPv6 user configuration --
DHCPv6Server IPv6 config$unicast-routing

```

### 4.2.2 Enabling the DHCPv6 Server on the interface

Access the interface's configuration menu and enable IPv6 and the DHCPv6 server. In addition, set the **other-config** flag in the *Router Advertisement* (RA) messages. Enabling this flag tells clients that they need to use the DHCPv6 server in *Stateless* mode to obtain stateless configuration information. The IPv6 address 2001:db8::1/64 is added to the interface. This will result in the prefix 2001:db8::/64 being added to the *Router Advertisement* for address auto-configuration.

This configuration allows clients to build their IPv6 address through SLAAC and to obtain configuration information such as DNS servers and domain names through the *Stateless* DHCPv6 server.

```

DHCPv6Server Config$network ethernet0/0
-- Ethernet Interface User Configuration --

```

```
DHCPv6Server ethernet0/0 config$ipv6 enable
DHCPv6Server ethernet0/0 config$ipv6 nd other-config-flag
DHCPv6Server ethernet0/0 config$ipv6 dhcp server enable
DHCPv6Server ethernet0/0 config$ipv6 address 2001:db8::1/64
```

### 4.2.3 Configuring the DHCPv6 server options

First access the DHCPv6 server as follows:

```
DHCPv6Server Config$protocol dhcpv6
-- DHCPv6 protocol user configuration --
DHCPv6Server DHCPv6 config$server
-- DHCPv6 Server Configuration --
```

Then add the DNS IPv6 servers, namely 2001:db8::100 and 2001:db8::200. This is the list of DNS IPv6 servers that will be delivered to clients upon request.

```
DHCPv6Server DHCPv6-Server config$option dns-server 2001:db8::100
DHCPv6Server DHCPv6-Server config$option dns-server 2001:db8::200
```

Next, add a domain name, namely **domain.example**. This domain name will be delivered to clients upon request.

```
DHCPv6Server DHCPv6-Server config$option domain-search domain.example
```

The resulting configuration for Scenario 2 is as follows:

```
log-command-errors
no configuration
set hostname DHCPv6Server
set data-link at cellular0/0
set data-link at cellular0/1
set data-link at cellular1/0
set data-link at cellular1/1
network ethernet0/0
; -- Ethernet Interface User Configuration --
    ipv6 enable
    ipv6 dhcp server enable
    ipv6 nd other-config-flag
    ipv6 address 2001:db8::1/64
;
exit
;
protocol dhcpv6
; -- DHCPv6 protocol user configuration --
    server
; -- DHCPv6 Server Configuration --
    option dns-server 2001:db8::100
    option dns-server 2001:db8::200
    option domain-search domain.example
    exit
;
exit
;
;
;
;
;
;
protocol ipv6
; -- IPv6 user configuration --
    unicast-routing
    exit
;
;
;
;
dump-command-errors
end
```

### 4.3 "DHCPv6 Relay" scenario

Consider the following example scenario:

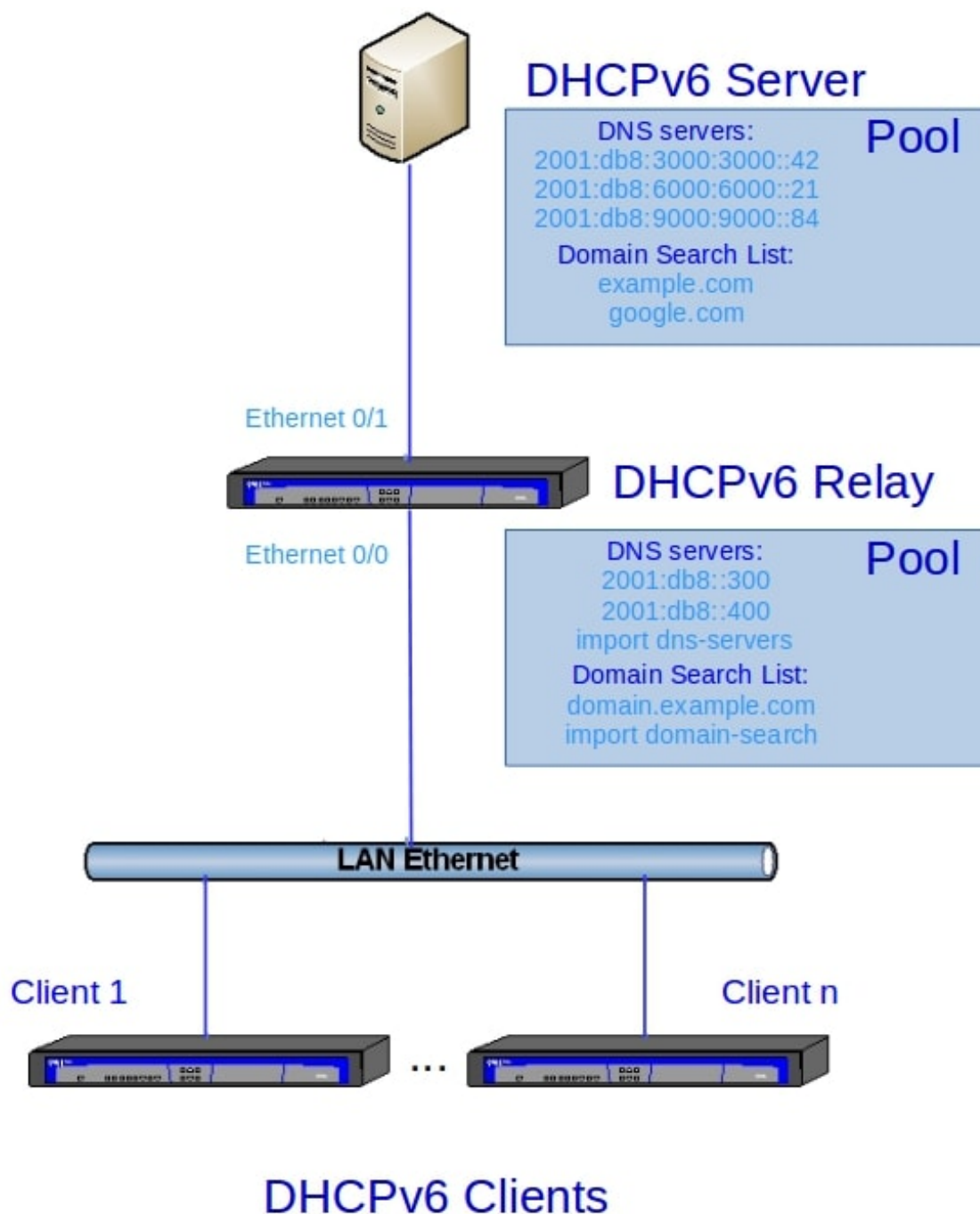


Fig. 6: Configuration example scenario

In the above scenario, the Teldat device is configured to act as a DHCPv6 relay, which means that it will perform both client and server behavior. The prefix delegation process is not mentioned in this example as it has already been explained.

The DHCPv6 client is responsible for obtaining the configuration parameters that the server is advertising. The DHCPv6 stateless server has an information pool where these configuration parameters are defined statically and/or imported from the DHCPv6 client.

The goal of this scenario is to replicate the information served by the DHCPv6 server to the DHCPv6 clients through the Teldat device, acting as an intermediary or relay in the process.

The configuration of the client and the server to simulate this relay behavior is described below.

### 4.3.1 Configuring the DHCPv6 client

The first step involves enabling IPv6 forwarding mode:

```
DHCPv6Client *running-config
DHCPv6Client Config$protocol ipv6
-- IPv6 user configuration --
DHCPv6Client IPv6 config$unicast-routing
DHCPv6Client IPv6 config$
```

After that, we define the DHCPv6 client on the Ethernet 0/1 interface:

```
DHCPv6Client *running-config
DHCPv6Client Config$network ethernet0/1
-- Ethernet Interface User Configuration --
DHCPv6Client ethernet0/1 config$ipv6 enable
DHCPv6Client ethernet0/1 config$ipv6 dhcp client pd dhcp-delegated-prefix
DHCPv6Client ethernet0/1 config$
```

Once the interface is connected to the server, the DHCPv6 client solicits a valid prefix and requests two configuration parameters: DNS servers and Domain Search List. If the server supplies the client with the requested information, the client will store it.

### 4.3.2 Configuring the DHCPv6 server

The stateless server configuration parameters are defined in a pool. They can either be configured statically (option `dns-server` ...) or imported from the parameters obtained by the DHCPv6 client.

In this scenario, there are two DNS servers and one domain name configured statically. This configuration is as follows:

```
DHCPv6Server *running-config

DHCPv6Server Config$protocol dhcpv6

-- DHCPv6 protocol user configuration --
DHCPv6Server DHCPv6 config$server

-- DHCPv6 Server Configuration --
DHCPv6Server DHCPv6-Server config$option dns-server 2001:db8::300
DHCPv6Server DHCPv6-Server config$option dns-server 2001:db8::400
DHCPv6Server DHCPv6-Server config$option domain-search domain.example.com
```

Importing the DNS servers and Domain names obtained by the DHCPv6 client can be done with the following commands:

```
DHCPv6Server DHCPv6-Server config$import dns-servers
DHCPv6Server DHCPv6-Server config$import domain-search
```

After that, the server itself has to be configured in the desired interface. In this scenario, the server is listening to the Ethernet 0/0 interface.

```
DHCPv6Server Config$network ethernet0/0
-- Ethernet Interface User Configuration --
DHCPv6Server ethernet0/0 config$ipv6 enable
DHCPv6Server ethernet0/0 config$ipv6 nd other-config-flag
DHCPv6Server ethernet0/0 config$ipv6 dhcp server enable
DHCPv6Server ethernet0/0 config$ipv6 address 2001:db8::1/64
```

Once the server configuration is finished, the DHCPv6 clients requesting stateless configuration will receive these parameters.

### 4.3.3 Monitoring DHCPv6 server pool

When the server is importing information from the client, the actual value of these parameters is not known beforehand. Therefore, the pool that the server is offering to clients can not be known exactly if we only refer to its configuration. To see its actual value, we must go to the monitor menu and display the information that is being sent.

To do this, follow these easy steps:

```
DHCPv6Server *monitor
DHCPv6Server +protocol dhcpv6
DHCPv6Server DHCPv6+server
DHCPv6Server DHCPv6-Server+list
DNS server/s:
  1. 2001:db8::300
  2. 2001:db8::400
  3. 2001:db8:3000:3000::42 (Imported)
  4. 2001:db8:6000:6000::21 (Imported)
  5. 2001:db8:9000:9000::84 (Imported)
Domain Search List:
  1. domain.example.com
  2. example.com (Imported)
  3. google.com (Imported)
```

As you can see, the statically-configured information and information imported from the client are listed. This is the actual pool that the server is offering to its clients.

### 4.3.4 Monitoring the DHCPv6 client leases

Meanwhile, the parameters that the DHCPv6 client receives can be listed in the monitor menu. This menu also displays the elapsed time since they were obtained and the amount of seconds until the next renewal process.

To display all the parameters received, enter the following commands:

```
DHCPv6Client *monitor
DHCPv6Client +protocol dhcpv6
DHCPv6Client DHCPv6+client
DHCPv6Client DHCPv6-Client+list
Client on interface ethernet0/1
DNS server/s:
  1. 2001:db8:3000:3000::42           Uptime: 2m46s  Renew in: 134 seconds
  2. 2001:db8:6000:6000::21         Uptime: 2m46s  Renew in: 134 seconds
  3. 2001:db8:9000:9000::84         Uptime: 2m46s  Renew in: 134 seconds
Domain Search List:
  4. example.com                     Uptime: 2m46s  Renew in: 134 seconds
  5. google.com                       Uptime: 2m46s  Renew in: 134 seconds
```